SEP 27 1943
PERIODICAL ROOM GENERAL LIBRARY UNIV. OF MICH.

SCIENCE

NEW SERIES
VOL. 98, No. 2543

FRIDAY, SEPTEMBER 24, 1943

SUBSCRIPTION, $6.00
SINGLE COPIES, .15

Useful, Inexpensive Temperature Indicators

Marks made by Tempilstiks melt and glisten when the stated melting point of the stick has been attained; they have many laboratory applications.

The Tempil Pellet on the left, melting point 1450°F., and the one on the right melting point 1500°F.. indicate that the temperature has reached 1450°F. but not 1500°F.

Tempilstiks

Tempilstiks are the crayon-like marking devices that produce marks which melt and glisten at specific temperatures. They have wide applications in heat treating and preheating operations, fabrication of metals generally, commercial processing and preparation of laboratory materials.

Tempilstiks

125° F.	400° F.
150°	450°
175°	500°
200°	550°
250°	600°
275°	650°
300°	700°
350°	

Each Tempilstik has a distinctive color and a stated melting point in the range shown below; measurements are accurate to ± 1%. A Tempilstik is sufficient for about 2,000 determinations; several are valuable to signal thermal limits.

Tempilstiks $2.00
(State melting point desired)

Tempil Pellets

Tempil Pellets are aspirin-size tablets which have melting points in the range shown below. Each Tempil Pellet melts at a temperature within ± 1% of its stated value and has a distinctive color. These pellets are particularly useful for temperature studies in the black heat range.

Tempil Pellets

750° F.	1200° F.
800°	1250°
850°	1300°
900°	1350°
950°	1400°
1000°	1450°
1050°	1500°
1100°	1550°
1150°	1600°

For uses where one temperature is to be signaled, a single tube of Tempil Pellets will serve; when a maximum and minimum temperature is to be observed, or where the progress of a heating operation is to be followed, several tubes are desirable.

Tempil Pellets, per tube of 20 pellets $2.00
(State melting point desired)

Manufactured and Distributed by

FISHER SCIENTIFIC CO.
717 Forbes Street, Pittsburgh, Penna.

EIMER AND AMEND
635 Greenwich Street, New York, N. Y.

Headquarters for Laboratory Supplies

Science: published weekly by The Science Press, Lancaster, Pa.
Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

ENTOMOLOGY

The Internal Anatomy of Dermacentor Andersoni Stiles

By J. R. Douglas

University of California Publications in Entomology

Volume 7, Number 10
Pp. 207–272, Plates 8–26

Paper $1.25

UNIVERSITY OF CALIFORNIA PRESS

Berkeley Los Angeles

Address all communications to the
University of California Press
Berkeley 4, California

ORGANIC CHEMISTRY

With Applications to Pharmacy and Medicine

By ELDIN V. LYNN, Ph.D.
Professor of Chemistry, Massachusetts College of Pharmacy, Boston

Octavo, 410 pages. Cloth, $4.50, net.

This work has been written to fill the urgent need for a textbook in organic chemistry which will give both the medical and pharmaceutical applications. It gives an adequate discussion to the important principles of modern organic chemistry and introduces, as illustrations, those compounds that are used in both pharmaceutical and medical practice.

LEA & FEBIGER

WASHINGTON SQUARE, PHILADELPHIA 6, PA.

C&B

Chemical Indicators

All of the common indicators used in analytical and biological work, the hydrogen-ion indicators recommended by Sorenson and Clark & Lubs, and many rare indicators suitable for special work, are available in C&B Chemical Indicators.

These indicators are obtainable in the dry form and in solution, ready to use.

Certain indicators are offered in the form of Test Papers—in vials containing 100 strips and in sheets 8″ x 10″.

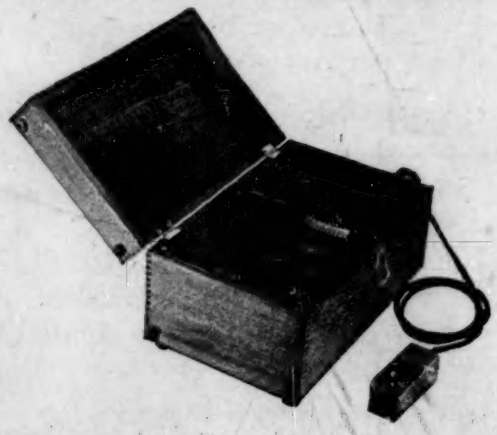
Catalog upon request.

The COLEMAN & BELL Co.
Manufacturing Chemists Norwood, Ohio, U.S.A.

COLEMAN & BELL

Exposure Determination in Photomicrography

by direct light measurement in plane of image



PHOTOVOLT Electronic Photometer MOD. 511

A highly sensitive light meter with phototube and amplifier

Also suitable for spectrophotometry, densitometry of spectrographs, micro-colorimetry, measurement of luminescence and fluorescence, ultraviolet emission and absorption. Obtainable with phototubes sensitive in the ultraviolet, visible, infra-red.

PHOTOVOLT CORP.
95 Madison Ave. New York 16, N. Y.

SCIENCE

VOL. 98 FRIDAY, SEPTEMBER 24, 1943 No. 2543

Aristotle, Newton, Einstein: PROFESSOR E. T. WHITTAKER 267

The Longevity of the Eminent: DR. HARVEY C. LEHMAN 270

Obituary:

Rennie Wilbur Doane: JOHN M. MILLER. *Leslie Leland Locke:* PROFESSOR LOUIS C. KARPINSKI. *Recent Deaths* 273

Scientific Events:

The North Pacific Planning Project; Escuela Agricola Panamericana; The Chicago Museum of Natural History; The National Metal Congress; The Louis Livingston Seaman Fund; Need for Water-Insoluble Forms of Water-Soluble Vitamins 275

Scientific Notes and News 278

Discussion:

Twenty-Five-Year Effort at Saving Nature for Scientific Purposes: DR. VICTOR E. SHELFORD. *On Methods of "Starring" American Men of Science:* DR. C. A. BROWNE. *Clavacin and the Press:* PROFESSOR H. W. ANDERSON 280

Scientific Books:

Blood Groups and Transfusion: PROFESSOR WILLIAM C. BOYD. *Chemistry:* DR. R. E. POWELL 283

Special Articles:

The Serological Activity of Denatured Antibodies: J. O. ERICKSON and DR. HANS NEURATH. *Protective Effect of Separate Inoculation of Spotted Fever Virus and Immune Serum by Intradermal Route:* PROFESSOR L. ANIGSTEIN, MADERO N. BADER and GERALD YOUNG 284

Scientific Apparatus and Laboratory Methods:

Observations on the Biological Value of a Mixture of Essential Amino Acids: DR. ANTHONY A. ALBANESE and VIRGINIA IRBY 286

Science News 10

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL; WARE CATTELL, assistant editor. Published every Friday by

THE SCIENCE PRESS

Lancaster, Pennsylvania

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington, D. C.

ARISTOTLE, NEWTON, EINSTEIN. II

By Professor E. T. WHITTAKER, F.R.S.

UNIVERSITY OF EDINBURGH

THE problem that now confronted physicists was this: How can local properties, such as a gravitational field, exist in space when the existence of an ether is not a permissible supposition? The answer was furnished, in 1915, by the "General Theory of Relativity" of Einstein. He discarded Gassendi's assumption that space was a uniform characterless vacuum, and postulated that it had a property of curvature, varying from point to point: and that just as (to make use of a rough analogy) a paramagnetic body when placed in a magnetic field tends to move from the weaker to the stronger places in the field, so a massive body in space might be pictured as moving from places of weak to places of strong curvature. The curvature, in fact, performs in general relativity the same kind of function as the density and rigidity of the ether did in classical physics; but, unlike the ether-properties, it does not come into conflict with the principle of relativity. In Einstein's conception, space is no longer the stage on which the drama of physics is performed: it is itself one of the performers; for gravitation, which is a physical property, is entirely controlled by curvature, which is a geometrical property of space.

In Einstein's theory of gravitation the Newtonian concept of force is completely done away with; a free particle moves in a path determined solely by the curvature-properties of space; it is, as the Aristotelians would say, in potency with regard to space, and things in a state of potency continually seek to become actualized. The changes of position of the particle, in their turn, bring about changes in the curvature of space, so that the particle and space together may be regarded as a single system whose evolution is determined by the law that the total curvature of space-

time is to be a minimum: as we may say, gravitation represents a continual effort of the universe to straighten itself out—a statement so completely teleological that it would certainly have delighted the hearts of the Schoolmen.

While classical physics was thus being undermined by the principle of relativity, an even more devastating attack on it was developing from the side of quantum-theory. In 1913 a young Danish research student named Niels Bohr, working under Rutherford in Manchester, published some new and revolutionary ideas regarding the way in which light is generated. Let us take as the simplest example the generation of light by a hydrogen atom. This atom consists of a massive particle in the center with an electron circulating round it, just as the earth and the other planets move round the sun. Now in the solar system a planet may revolve at any distance whatever from the sun—that is to say, there is no restriction on the dimensions of the planetary orbits; and similarly, according to classical physics, the electron in the hydrogen atom might revolve at any distance whatever from the nucleus—the possible orbits would form a continuous sequence. Bohr, however, now put forward the suggestion that this deduction from classical physics is false, and that, in fact, only certain particular orbits are allowable; just as if in the solar system a planet could move in the orbit of the earth, or in that of Mars or Jupiter, but could not move in any orbit intermediate between these, such as the orbits in which the minor planets actually do move. When the electron is moving in one of the permitted orbits the atom is said to be in a stationary state; and the fundamental assumption of Bohr's theory is that the atom, when it is not emitting light, must always be in one or other of the stationary states, without the possibility of its being in any intermediate condition: the emission of light takes place when, and only when, the atom changes from one stationary state to another.

Bohr showed that his suggestion would explain many of the known features of spectra most admirably; but some serious objections could be brought against it, and one of them was that he could give no explanation of the process by which an atom in a state A is raised or lowered to another state B. In the change the electron must transfer itself from the orbit belonging to state A to the orbit belonging to State B; and according to the Gassendi-Newton doctrine, an object such as an electron can transfer itself from one position to another position only by traveling over the space between them, occupying in succession the whole continuous sequence of intermediate positions. Bohr, however, found it impossible to provide any description of the transference of the electron, and was compelled to renounce the attempt to explain transitions between stationary states. At the time, this was regarded as an imperfection in his work. In the light of our knowledge to-day, we take a very different view, and regard Bohr's renunciation as one of the most valuable and permanent features in his theory, and as a landmark in the history of science; for the subsequent development of quantum-mechanics has shown that his inability to trace the adventures of the electron between leaving orbit A and settling in orbit B was not due to any insufficiency on his part, but was inherent in the physical situation.

What is the difficulty? Is it that the mathematical operations required to calculate the motion are so intricate as to be beyond the skill of the best mathematicians? Or is it that owing to the imperfections of our laboratory apparatus we can not make measurements of sufficient delicacy to specify empirically the successive stages of the motion? No, the trouble is more deeply seated. Even if we could imagine an investigator capable of solving any set of mathematical equations whatever, and, moreover, possessing instrumental equipment of the highest refinement conceivable, even then the problem of depicting in terms of the concepts of classical physics the transition of the atom from one stationary state to another would be insoluble; and the reason is, that the process can not be described as a continuous movement of an electron in space. We are confronted by a theoretical impossibility, like the impossibility of expressing π as a rational fraction or the impossibility of constructing a regular heptagon with ruler and compasses.

The importance of this discovery is that it invalidates the presuppositions of the whole Gassendi-Newton doctrine. It shows that there are events in the physical world which can not be represented on the background of space and time.

It therefore becomes necessary to find a metaphysics different from that which has been associated with classical physics; for metaphysics must (as Aristotle held) originate with reference to physics, since it is the conceptual framework into which our experience of nature is to be fitted. The progress of science has destroyed the foundations on which natural philosophy has hitherto been grounded. How is the damage to be repaired?

Evidently space and time must be deposed from the dominant position which they held in Newtonianism, and relegated to a status more or less resembling that which they had in the Scholastic philosophy; and therefore we must now begin not with space and time, but with fundamental physical events, such as the one which has just been occupying our attention, namely, the assumption by the atom of its different possible stationary states. The atom, which has a potency of

various states, is correlated to the states, as potency to act. It endures as the atom, while it takes different states in succession. This is precisely the aspect of things on which Aristotle fixed his attention: that substratum which persists while receiving different determinations is what in the Aristotelian-Scholastic philosophy is called matter; whereas the structural principle, which is peculiar to each determination or state, is called form. The atom, then, is matter with respect to its states, which are forms.

The same principles can be applied in one of the most recent of physical theories, that of the nucleus of the atom. The nucleus is generally said to be composed of two kinds of elementary particles, called protons and neutrons; but in the quantum-mechanical theory of processes such as the emission of beta-rays, the proton and neutron are regarded as two "states" of a single entity, often called a "heavy particle." Here, then, the heavy particle would be "matter," and its determinations as a neutron or proton would be its two possible "forms."

Matter is correlated to form, as potency to act—notions which may again play an important part in the natural philosophy of the future, as they did in pre-Newtonian days.

In the light of the Aristotelian-Scholastic concepts, certain otherwise puzzling facts, which have been discovered in modern investigations, fall into their places as elements of a rational coherent system. Take, for example, the fact that all electrons have the same electric charge. For this, the classical theory of electricity has no explanation to offer: the law of interaction is that two electrified particles repel each other with a force proportional to the product of their charges and inversely proportional to the square of the distance between them; and this law is valid whether the charges are equal or unequal. Yet it is impossible to believe that the actual equality of the charges of electrons is a mere accident: it must be fundamental in the scheme of nature, and there must be a reason for it. How fundamental and necessary it is has been shown by a study of the forces by which atoms are held together so as to form molecules. Take, for instance, the hydrogen molecule, which is constituted of two hydrogen atoms, each atom consisting of a nucleus and an electron. If the two electrons are interchanged with each other, there is no change in the system, since the electrons are identical. From which feature of the situation, by following up its consequences in the light of quantum-mechanics, we can predict that a stationary state of the system exists which has less energy than the energy of the two atoms when separated: this stationary state corresponds to the stable hydrogen molecule.

In the proof, everything turns on the exact equality of the two electrons. If they had different charges, the binding force (which is purely quantum-mechanical) would not exist; and this is true of all those binding forces which are called "homopolar bonds" in chemistry. Thus the world would be a very different place from what it is, if all electrons were not identical.

But the matter is not yet exhausted. There is something more profound: electrons are indistinguishable in a still more rigorous sense. If two electrons are at one instant at places A and B, and at a later instant at places C and D, it is impossible to say which of the electrons at C and D is the one which was formerly at A—that is to say, an electron can freely exchange its recognizability with other electrons; it has no sameness of being, no proper identity, no separate history. Its selfhood is merged in an electronhood which it shares with all other electrons, and which is correlated to it as potency to act. From the philosophical point of view this is clearly important, for it necessitates a revision of the concept of individuality as applied to the elementary particles, and reopens, in connection with the most recent discoveries in physics, the question which engaged so much attention in the Middle Ages, regarding the nature of universals or general terms, which represent the common basis of a class of individual objects.

The transition which is now in progress from classical physics to a new natural philosophy conformable to relativity and quantum-mechanics is less violent than that which took place three centuries ago, when classical physics arose on the ruins of Aristotelianism, but it may prove not less significant. As we have seen, it involves a return to some fundamental Aristotelian notions, which have again become a living force; and this should lead to more intercourse and mutual understanding between men of science and philosophers; for of all types of philosophy, the Aristotelian-Scholastic is, in its principles, the most congenial to the scientific mind. Like men of science in all ages, the Schoolmen never doubted the existence of an objective world that was independent of human cognition; they were untroubled by difficulties such as those raised later by Berkeley, Hume and Kant; they looked outwards towards a reality external to themselves, and analyzed their experience of it. They held that all our knowledge is derived primarily through the senses, which come into direct contact with concrete things. The sense-impression is subjected to the operation of the active intellect, which throws light upon it, as it were, divesting it of its contingent elements and making it intelligible by drawing out the idea or concept contained in it. The idea so obtained is the means

whereby knowledge is acquired. Thus the human intellect is capable of conceiving relations such as cause and effect, and of apprehending Being as such; metaphysics is possible, and completes physics by ascending to the true understanding of reality.

All this fits in very well with the scientific man's view of what metaphysics ought to be. But if the prospect of a movement in the direction of Aristotelianism is agreeable to the investigator of nature, it may prove not less so to the philosopher. For the Cartesian revolution, which dethroned Aristotle, severed the philosophic and scientific traditions from each other, and made it impossible to incorporate physics into an all-embracing doctrine of reality. The impoverished representation of the objective world which Descartes obtained by abstracting only its purely quantitative aspects was a soulless mechanism, composed of parts which had no function except to move each other about in space; and this function was itself philosophically inexplicable and had no relation to any ideas of value or purpose.

The inherent defects of Newtonianism, the result of its dependence on the concepts of Descartes and Gassendi, were perceived by Leibnitz. In his controversy with Clarke he discussed the tendency, which had become common in Newtonian circles, to conceive of the relation between God and the universe as analogous to that of a watchmaker to a watch which he has constructed, and which, having been set going, continues to function, for some time at any rate, without any necessity for the continued presence or attention of its originator. Such a conception led inevitably to the idea of an absentee God, who, having created the world, had left it to run its own course without further divine intervention and who was therefore for practical purposes non-existent. As Leibnitz saw, it is impossible to build any religion as a superstructure on a purely mechanical philosophy; and, in particular, Christianity, being an incarnational and sacramental religion, is incompatible with any view of the world which completely despiritualizes matter.

The debate between Leibnitz and Clarke took place in the lifetime of Newton, who, however, did not participate in it. Though profoundly interested in theology, he seems to have held that the physicist is not under any obligation to concern himself with metaphysics; he can give his undivided attention to investigating the laws which will enable him to predict phenomena, and can leave the deeper problems entirely out of account; he can make it his purpose to describe rather than to explain. This is one of the implications of his celebrated declaration *hypotheses non fingo*,[10] and it determined the attitude of his successors—that is to say, men of science since Newton have generally held that correct (even if in some respects limited) knowledge regarding physics can be combined with any views whatever on the fundamental questions of being and reality; that part of the world can be rightly understood without reference to the whole; that natural philosophy is independent of metaphysics.

In a restricted sense this doctrine is true. The fact can not be disputed that great discoveries regarding the behavior of the external world have been made by workers whose investigations in their field of research were not related in their own minds to any interest or belief outside it. But the effect of such segregated thinking has been to make science a departmental affair, having no influence on life and thought except indirectly through its applications. At the present time there is a movement in scientific circles aiming at securing for science a greater influence on human affairs, and even calling for a refounding of civilization on a scientific basis; but its advocates do not always understand that, as a necessary condition for the possibility of such a reform, science must be reintegrated into a unity with philosophy and religion.

THE LONGEVITY OF THE EMINENT

By Dr. HARVEY C. LEHMAN
OHIO UNIVERSITY

IN an article published in the *Journal of the American Medical Association*[1] Dr. R. A. Rendich states that the most prominent physicians—those whose death notices receive the most space in the *Journal*—die on the average 4.7 years earlier in life than do those whose demise receives only a bare mention. Although Rendich presents no data which would enable a critical reader to draw any valid conclusion regarding the statistical significance of this apparent difference in longevity, Rendich assumes that the most prominent physicians really are less long-lived than are somewhat less successful physicians and he assumes further that their shortened life is the price that the prominent physicians pay for success or prominence in the medical world.

In a subsequent study,[2] Mills, who analyzed 1,036 obituary notices which were published in the same

[1] R. A. Rendich, *Jour. Am. Med. Asn.*, 119: 1041, 1942.

[10] "Principia," *Schol. gener. sub finem.*

[2] C. A. Mills, SCIENCE, 96: 380–381, 1942.

journal, obtained a curvilinear relationship between mean age at time of death and the number of lines in death column notices. In interpreting his data, however, Mills centers his attention primarily on one end of his curve almost to the exclusion of the other, *i.e.*, on the fact that those physicians whose death notices contain 21 or more lines died at the mean age of 70.59 years. Mills pays scant attention to the fact that the physicians whose obituary notices contain only 2 lines died at the greater mean age of 71.28 years. The fact that Mills found a *curvilinear* relationship between mean age at time of death and the number of lines in death column notices should certainly have caused him to doubt the real significance of his findings. However, Mills displays no such doubt. The gist of Mills's one-sided conclusion is summarized by him in the following words: ". . . the great seem not so inclined to die young or break down in the struggle as are the somewhat less successful; instead, their heritage appears more likely to be a ripe old age."[3]

Mills and Rendich both seem to assume that the number of lines devoted to one's obituary is a valid measure of greatness or eminence, and both of these investigators assert that the longevity of the very eminent differs markedly from the longevity of those who are somewhat less successful. Nevertheless, these two workers arrive at diametrically opposed conclusions.

For a number of years the present writer has been studying the chronological ages at which outstanding leaders are most likely to reach the high points of their careers.[4] He has studied also the chronological ages at which various kinds of creative thinkers are most likely to accomplish those things which enable them to attain eminence.[5] In making the foregoing studies, statistical distribution tables were assembled which set forth both the ages of attainment and also the ages at time of death for almost 200 different groups of eminent individuals. Since the foregoing data were already assembled for the above-mentioned purpose, it was a relatively simple task to compute for each of these groups of exceptional individuals both the mean age at time of accomplishment and the mean age at time of death. What is found when data for this large number of groups are examined?

(1) The longevity of groups of eminent individuals who were born prior to about 1775 was compared with the longevity of other groups of eminent individuals (in the same fields of endeavor) who were born from 1775 to 1850. In some instances the earlier-born groups were found to exhibit greater longevity and in other instances the later-born groups displayed greater longevity. On the whole, however, there was no consistently reliable difference between the longevity of the later-born and the earlier-born groups.[6]

(2) Nineteen different comparisons were made between groups of creative thinkers who are recognized by experts as topflight performers and other groups of creative thinkers in the same fields of endeavor who are somewhat less eminent. No consistent differences in longevity were found.

(3) A careful study was made of the longevity of various types of eminent individuals—musicians, inventors, mathematicians, and so forth. Differences in mean age at time of death were found for these various groups, and some of these differences were statistically significant. For example, the composers, the poets and the painters in oil seemed to be somewhat less long-lived than the other groups with which they were compared. However, the group differences in longevity within a given field of endeavor were fully as great as were the median group differences among the different fields.

Thus, for 19 groups of painters in oil the mean age at time of death for the median-lived group was 59.14 years. And for 33 groups of scientists, mathematicians and inventors, the mean age at time of death for the median-lived group was 66.05. The median-lived group of scientists *et al.* thus lived on the average 6.91 years longer than did the median-lived group of painters in oil. But the difference in the mean longevity of the longest-lived and the shortest-lived groups of oil painters was 9.92 years. Similarly, the difference in the mean longevity of the longest-lived and the shortest-lived groups of scientists was 6.02 years. Numerous other such comparisons as the foregoing led to the conclusion that, within a given field of endeavor, the group differences in longevity are fully as great as are the group differences from field to field.

(4) For 35 groups of leaders (political, religious, judicial, legislative, military, educational and the like), the correlation between mean age at time of qualifying for membership in a particular group and mean age at time of death was found to be +.89. When 5 of the foregoing 35 groups were excluded from the computation[7] because these 5 groups seemed to have produced a spuriously high positive correlation, the resultant r dropped to +.70. This fairly high positive correlation suggests that various leaders have exhibited much of their longevity prior to qualifying for membership in their particular group.

[3] *Ibid.*, p. 381.
[4] H. C. Lehman, *Scientific Monthly*, 54: 162–175, 1942.
[5] H. C. Lehman, SCIENCE (in press).
[6] *Cf.* in this connection, E. G. Dexter, *The Independent*, 118: 185–187, February 12, 1927.
[7] These 5 groups consisted of hereditary sovereigns, born long ago, who had attained their thrones at quite early ages and who also had died at relatively youthful ages.

For example, the average age at time of death for the 29 Presidents[8] of the United States who have died is 68.3 years. The men who become this country's chief executives must, in the very nature of things, be a relatively long-lived group, for no one is elected to this high office until he has reached middle age at least. The state governors of the United States, born prior to 1850, have died at a lower mean age than have the Presidents, but these state governors have also been elected to their governorships at younger age levels. It seems clear, therefore, that any comparison with respect to the longevity of these two groups will be of doubtful significance until mean age at time of entry to the group in question is taken into account. Similarly, the positive r of +.70 between mean age at time of qualifying for membership in a given group of leaders and mean age at time of death, suggests that no wholesale comparison of the longevity of groups of leaders will be very meaningful until the mean age at time of entry into each group has been allowed for.

Table 1 sets forth the mean ages in years at time of death for 25 groups of eminent individuals. At the top of the list is a group of 248 cabinet members of the Presidents of the United States. For these 248 cabinet members the mean age at time of death was 71.39 years. At the bottom of this same list is a group of 213 hereditary European sovereigns who died at the mean age of 49.14 years. For the 248 cabinet members and the 213 hereditary sovereigns the mean difference in longevity is 22.25 years, and this difference is statistically reliable, the critical ratio being 15.76. Must one infer that the lesser longevity of the hereditary sovereigns is the price that was paid by these individuals for being hereditary rulers? This latter conclusion does not necessarily follow. The 248 cabinet members were first sworn in at the mean age of 51.21 years, whereas the hereditary rulers qualified for membership in their particular group at the mean age of only 30.00 years. For these two groups the difference in their mean ages at time of entry into their respective groups is thus 21.21 years; almost the same number of years as the difference in their longevity, namely, 22.25 years. Indeed, when the average cabinet member was first appointed he was already older than was the hereditary ruler at time of death. These data, therefore, may merely reflect the obvious fact that it is impossible for those who die young to become members of the President's cabinet in the United States. Certainly, a group of individuals who have died at the mean age of 49.14 years could not have qualified for any office at the mean age of 51.21 years.

TABLE 1

MEAN AGES IN YEARS AT TIME OF DEATH FOR VARIOUS TYPES OF EMINENT INDIVIDUALS

	Type of worker	Longevity Mean	P.E. of Mean
248	Members of the President's Cabinet in the U.S.A.	71.39	0.721
202	Entomologists	70.99	0.825
402	Inventors	70.96	0.628
211	Historians	70.60	0.801
249	American College and University Presidents	70.11	0.786
236	Geologists	69.79	0.855
216	Chemists	69.24	0.956
405	Educational Theorists	69.06	0.602
1,172	Educators, all kinds*	68.98	0.371
423	Economists and Political Scientists	68.68	0.596
537	Contributors to Medicine and Public Hygiene	68.57	0.560
221	Botanists	68.36	0.898
807	Philosophers	68.22	0.472
203	Historical Novelists	67.89	0.928
413	State Governors (U.S.A.)	67.02	0.597
757	Authors of Words to Church Hymn Tunes	66.94	0.545
177	Mathematicians	66.62	1.107
357	Composers of Grand Opera	66.59	0.737
273	Composers of Choral Music	66.51	0.816
274	Composers of Chamber Music	66.26	0.717
407	Naval and Military Commanders (born from 1666 to 1839)**	66.14	0.689
244	Authors of Political Poetry	64.47	1.011
305	Painters in Oil	64.22	0.763
543	British Authors†	63.91	0.648
213	Hereditary European Sovereigns	49.14	1.146

* These data were obtained and published by G. W. A. Luckey, *School and Society*, 28: 244–248, 1928.

** For 309 Naval and Military Commanders born prior to 1666 the mean age at time of death was 55.69 years.

† The list of British authors includes numerous poets.

W. R. Miles[9] reports the following data regarding the life-spans of certain eminent Greeks:

> I will mention four professional groups for each of which the number of cases is not too trivial: 38 philosophers lived on the average to 78.8 years, 26 writers (poets) 79.3 years, 25 writers (historians, critics) 78.4 years, and 10 orators, 71.6 years. The average was 77 years and 45 per cent. of the group reached the 80-year mark.[10]

Although the number of his cases is not large, it is noteworthy that *each* of the four groups mentioned by Miles exhibited greater longevity than *any* of the 25 groups for which data are presented in Table 1. Does this difference in longevity signify that the ancient Greeks were hardier individuals who lived longer than we moderns because of their greater hardiness? Not necessarily. The difference in the mean life-spans of Miles's 4 groups of ancient Greeks, as compared with the 25 more modern groups for which data are presented in Table 1, may be due merely to what this article has emphasized repeatedly, namely, *differential selective factors*. That is to say, this difference in longevity may have resulted from a difference in the selective factors operating then and now. It may well be that, in the recent past, an indi-

[8] Because of their small number, the Presidents of the United States were not included in the 35 groups of leaders.

[9] W. R. Miles, SCIENCE, 81: 79–87, 1935.

[10] *Ibid.*, p. 381.

idual could attain eminence in intellectual fields at a nore youthful chronological age than he could during he time of the early Greeks. The age-curves which ccompany a recently published article[5] lend some upport to this hypothesis.

Table 2 sets forth, for six types of creative think-rs, the *r* between mean age at time of accomplishment and mean age at time of death. None of the 126 groups for which data are presented in Table 2 contained less than 50 individuals. It will be noted in Table 2 that in each instance the *r* between mean age at time of achieving and mean age at time of death is positive. These positive *r*'s suggest once again that the conclusion already stated with reference to leaders holds also for the 126 groups of creative thinkers, *i.e.*, that if one is to understand the real significance of whatever relationship may be found between longevity and superior performance, it will first be necessary to take accurate account of the mean ages at which the creative thinkers have demonstrated their superiority. In so far as the present writer is aware, this has never been done and, except for calling attention to the problem, no attempt has been made to do this in the present study.

TABLE 2

THE CORRELATION BETWEEN MEAN AGE AT TIME OF DEATH AND MEAN AGE AT TIME OF ENTRY TO VARIOUS GROUPS OF EMINENT INDIVIDUALS

Type of worker	*r*
21 groups of composers	+.46
11 groups of philosophers	+.31
19 groups of oil painters, etchers, etc.	+.61
20 groups of scientists, mathematicians, inventors	+.24
13 groups of contributors to medicine, surgery, etc.	+.93
12 groups of authors	+.56

OBITUARY

RENNIE WILBUR DOANE

1871–1942

THROUGH the death of Rennie Wilbur Doane on December 1, 1942, the science of entomology lost one of its most valued workers in both its teaching and its applied phases. His work in applied biology began at a time when economic entomology was entering a period of expansion in many of its useful fields of service. It was characteristic of the man that he should have chosen entomology as a career during one of its formative periods and that the record of his life has been one of pioneering effort. His interests have been broad, rather than specialized, and his contributions to his chosen work have been many and varied.

Mr. Doane was born in Des Moines, Iowa, on March 11, 1871. As a boy he moved with his parents to Kansas and later to Southern California, where he received his earlier schooling. He was twenty years of age when a new university on the Pacific coast, Stanford, was opened in 1891; and he entered with its first freshman class. As a self-supporting student, he found it necessary to interrupt his university course by one year of outside employment, but he returned to complete his collegiate work and graduate in 1896.

English literature was first selected by Mr. Doane as his major, but in his elective courses he was attracted by the men of the Stanford faculty who were teaching the biological sciences. In addition to David Starr Jordan, he came under the influence of J. H. Comstock, professor of entomology; and V. L. Kellogg, assistant professor. It was the stimulation of these men that led him to change his major to zoology and entomology in 1894, and it was from this department that he received his degree. Later he returned for graduate work, and it can be said that it was the influence of Vernon Kellogg which had much to do with the outlook upon entomology which was formulated by Mr. Doane during his undergraduate and graduate studies and his first years of teaching.

Following his graduation he went to Washington State College, where he taught zoology and entomology from 1896 to 1901, rising to the rank of assistant professor. It was while here that he married Elanora Cooper in 1898, who now surives him. His next position was that of superintendent of the Fisheries Experimental Station located at Keyport, Wash. Much of his work at this station from 1901–1903 was concerned with research dealing with the propagation of the native oyster, an important natural resource of the state of Washington.

In 1905 Professor Doane returned to Stanford, where he was to play an important part in the development of economic entomology on the Pacific coast. He first entered the faculty as instructor and curator in entomology, which then had the status of a department under Vernon Kellogg. In 1920, when Dr. Kellogg resigned to become a member of the National Research Council, entomology at Stanford was incorporated with the department of zoology and Mr. Doane was named associate professor. In 1926 he became full professor of zoology (entomology) and continued in this position until 1937, when he retired as emeritus professor.

Throughout his career at Stanford, Professor Doane was active in assignments which called for the exploration of new and varied problems in applied entomology. One of the first of these was in 1908, when he made an investigation of the insect pests of cocoanut trees in the Society Islands. The most important problem encountered on this trip was that of a scale

insect, *Aspidiotus destructor*. In 1913 he was called to the Samoan Islands on a similar study for the copra industry in which the most important insect pest proved to be a rhinoceros beetle, *Orycetes rhinoceros*.

It was in 1908 that Professor Doane began a study of insect problems connected with the destruction of plant life in the vicinity of industrial plants in the western United States. These problems were for the most part localized around the ore-smelting and chemical plants in the mining districts. He became a recognized authority in this field and his services as consulting entomologist were often requested by industrial corporations. Yet another phase of applied entomology that drew his interest was the control of mosquitoes in the San Francisco Bay area, where for many years he was chairman of the Matedero Mosquito Abatement District.

In taxonomic entomology Professor Doane was interested in Diptera and very early in his work specialized in the Trypetidae and Tipulidae. While at Washington State College he brought together large collections of both families and described many new species. He continued his work on this group while at Stanford, where he described a number of new species of Tipulidae, some of which were of economic importance.

Professor Doane is remembered by his students as an energetic, kindly instructor who was always ready to guide and help them in the acquisition of useful knowledge. In 1908 there was a small group of advanced students at Stanford who were planning to enter forestry and desired instruction in forest entomology. To accommodate this group he instituted a course in forest insects, based primarily upon the insect problems in western forests. This was one of the first, if not the first, courses in forest entomology set up by any of the larger universities in the west; and in its first year it called for the cooperation of class and instructor in getting the most out of the material available. The course was developed and continued throughout the remainder of his teaching career. Later, as forest entomology became recognized at other schools on the Pacific coast, Professor Doane took the leadership in combining under joint authorship with E. C. Van Dyke, W. J. Chamberlain and H. E. Burke a text-book, "Forest Insects," which was published in 1936.

The teaching of entomology in its application to diseases that affect man was among the more important courses which he covered during his long career at Stanford. This subject formed the material for his first book, "Insects and Disease," which was published in 1910. In 1915 he published with Dr. Kellogg a text-book, "Economic Zoology and Entomology." "Common Pests," a reference book dealing with insects and other pests affecting man, was published in 1931.

Both in his teaching and in his writing, Professor Doane possessed the facility to express technical material in clear, simplified language. A list of his publications prepared by Dr. G. F. Ferris shows a list of fifty articles and books. The published papers covered his taxonomic work on the Tipulidae and Trypetidae, the results of his investigations of insect enemies of the cocoanut palm, an article on the mosquitoes of the Society Islands, an article on mosquito control and several papers on western forest insects.

He was a member of a number of scientific societies, including the American Association for the Advancement of Science, the American Association of Economic Entomologists, the Ecological Society of America and the Sigma Xi.

The last years of Professor Doane's life were troubled by frequent periods of illness, but these did not break his always forward outlook or his enthusiasm in planning for things ahead. Among his most characteristic qualities were his energy and his tenacity in completing those tasks which he considered worth while. He always took a deep personal interest in the welfare of his students that followed them into the later walks of life. His wide background of experience and inborn kindliness made him a valuable counselor to all those who came within his influence. Once he recognized promise and worth in those with whom he worked, his loyalty and sympathy never faltered.

JOHN M. MILLER

U. S. BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE,
UNIVERSITY OF CALIFORNIA AT BERKELEY

LESLIE LELAND LOCKE

LESLIE LELAND LOCKE, long well known as an authority upon the history of mathematical instruments, in particular the Peruvian quipu and calculating machines, died at his home in Brooklyn at the age of sixty-three years, on August 28, 1943.

In addition to many scientific articles in mathematical journals, Professor Locke wrote an authoritative work, "The Ancient Quipu or Peruvian Knot Record," published in 1923 by the American Museum of Natural History, with a supplement in 1928.

His collection of early calculating machines was presented by Mr. Locke recently to the Smithsonian Institution. Valuable early American text-books were presented by Mr. Locke to the University of Michigan.

After graduation at Grove City College and postgraduate work at Grove City College (A.M. in 1900), Pennsylvania State College, Cornell University and Columbia University, Mr. Locke taught at Michigan State College, before establishing his teaching in

Brooklyn. First at Adelphi College, and then for twenty-two years at Brooklyn College and the Technical High School, Mr. Locke established a reputation both as an able teacher and a learned investigator and writer on the history of mathematics.

LOUIS C. KARPINSKI

RECENT DEATHS

DR. JOHN M. MACFARLANE, since 1920 professor emeritus of botany of the University of Pennsylvania, died on September 16 at the age of eighty-seven years.

DR. FREEMAN WARD, professor of geology and head of the department of geology of Lafayette College, died on September 14. He was sixty-four years old.

DR. IVON R. TAYLOR, associate professor of psychology at Brown University, died on September 20. He was forty-five years old.

DR. CHARLES E. RESSER, since 1914 assistant curator of paleontology and curator of invertebrate paleontology and paleobotany at the Smithsonian Institution, died on September 17 at the age of fifty-four years.

HAL W. HARDINGE, mining and metallurgical engineer and inventor, died on September 15. He would have been eighty-eight years old on September 30.

SCIENTIFIC EVENTS

THE NORTH PACIFIC PLANNING PROJECT

AT a meeting last August, according to *The New York Times*, the National Resources Planning Board suggested to the co-chairmen of the Joint Economic Committees of the United States and Canada that the possibilities of the North Pacific region would merit careful study. As a result the two nations have begun the North Pacific planning project, the first step of which is to study the area preliminary to considering proposals for developing its resources, improving living standards and increasing the population, now about one hundred thousand.

The joint committees decided to sponsor such a survey, and the following aims have been announced:

(1) Enhanced security for Alaska, Canada and North America through well-conceived development of the North Pacific.

(2) Positive and active use of the area as a strategic key in a post-war system of world security.

(3) Development of the resources and transportation advantages as contributions to a better balanced continental economy.

(4) Development of economic opportunity for demobilized service-men and others who are adaptable to the region.

(5) A demonstration of the potential benefits of international collaboration in the development of backward and unoccupied areas; a testing of the various devices for implementing collaboration between all the governmental and corporate organizations and commissions and treaties between the two nations.

The United States National Resources Planning Board has provided the full-time assistance of its Alaska regional office staff, with headquarters at Portland, Oregon. James C. Rettie, of Portland, has been designated United States co-director. Actively participating are the Departments of State, Agriculture and Interior and the Board of Economic Warfare, together with Federal and territorial agencies in Alaska. For Canada, Dr. Charles Camsell, deputy minister of the Department of Mines and Resources, has been named Canadian co-director, with agencies of the Dominion and of the provincial government of British Columbia cooperating.

The specific boundaries of the territory to be considered have not yet been clearly defined, pending the outcome of the study. Mr. Camsell said that the territory embraces part of Alberta, the northern half of British Columbia, the Yukon Territory, Alaska and the Mackenzie River portion of the Northwest Territories. He said that the eastern boundary would take in all territory which had any bearing on the economic aspect of the new Canada-Alaska highway and its related air routes.

ESCUELA AGRICOLA PANAMERICANA

THIS institution, situated twenty-five miles from Tegucigalpa, capital of the Republic of Honduras, opened its doors on September 1 with seventy-four students representing seven countries—Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama. Its establishment was made possible by a gift of $500,000 from the United Fruit Company of Boston. It is governed by a board of directors composed of Samuel Zemurray, president; W. Latimer Gray, secretary-treasurer; Thomas Barbour, Thomas D. Cabot and T. Jefferson Coolidge. Operation is carried out through a board of regents, of which the members are Wilson Popenoe, chairman; Fernando Castro C., Luis Landa, Carlos Mirón, Doris Zemurray Stone, W. L. Taillon and Walter E. Turnbull.

All students enjoy full scholarships, including transportation from their homes to the school, board, lodging, clothing, laundry service, medical attention and tuition. Equipment includes 3,500 acres of land, lying between 2,500 and 5,000 feet in elevation; a

main building to be known as "Zemurray Hall" (not yet completed); dormitories, a dining hall, residences for the staff, a modern dairy and cold storage plant and various minor structures.

In founding Escuela Agrícola Panamericana it was the purpose of the United Fruit Company to cooperate in a practical manner toward the further development of agriculture in the Latin American countries. To this end the school will not only furnish instruction to a considerable number of Latin American (chiefly Central American) youths, but also will conduct experiments, especially with a view toward the introduction of new crop plants and improved varieties of those already cultivated, the diversification of tropical American agriculture and the improvement of the tropical dietary.

In choosing the teaching staff, especial care has been taken to select men with long practical experience in tropical agriculture. The department of agronomy and soils is headed by Alfred F. Butler; that of livestock and dairying by E. A. Rivera; and that of agricultural engineering by H. A. von Wald. Juvenal Valerio R., formerly director of the Museo Nacional at San José de Costa Rica, is professor of natural sciences, and Augusto Arís de C. is professor of English. Instruction during the first year centers mainly upon mathematics, English and the natural sciences. All students do classroom work only in the afternoons, the mornings being spent in field practice. The full course will require three years, following which an opportunity for specialization will be given those students who have demonstrated unusual ability.

WILSON POPENOE,
Director

THE CHICAGO MUSEUM OF NATURAL HISTORY

FOLLOWING are excerpts from the address of Stanley Field, president of Field Museum for the past thirty-five years, as delivered before the audience attending the ceremonies marking the fiftieth anniversary of the founding of the museum, held on the evening of Wednesday, September 15, in the James Simpson Theater of the museum:

At this time I have the privilege of making two important announcements. First: Mr. Marshall Field, grandson of the founder, has advised the trustees of his intention to give to the museum certain pieces of property that should produce an income at least equivalent to what his annual contributions have been in recent years. Mr. Field has been very generous to the museum; he has financed expeditions, purchases of collections, maintenance of the building and operating expenses, and is solely responsible for the pension plan which makes liberal provision for all the employees; without his aid and the great interest he has taken in all its activities, the museum could not have reached the splendid position it occupies to-day. His contributions total $2,852,000, without any reference to the gifts he is now proposing to make, so you can see what an important part he has played in the growth and standing of the museum.

While the gift of Mr. Field is very substantial, it is only his part in providing for a future which we hope may be on a scale suited to the standing of the institution, and to the importance of the great public and territory which it serves.

The museum must therefore look to other public-spirited citizens in the future as it has in the past, for continued contributions to its support and development.

CHANGE OF NAME

My second announcement has to do with the name of the museum. The museum has had three names: Columbian Museum of Chicago—Field Columbian Museum—and Field Museum of Natural History. Mr. Marshall Field has discussed with me several times the matter of the name of the museum. He has felt that since the museum was created and maintained for the public and has become identified in the minds of the public as a Chicago institution, and since it is now playing a growing and important part in the educational activities of the city—it would be appropriate, and also in the best interests of the museum, if the name were changed to Chicago Museum of Natural History, thereby identifying its ownership more closely with the public of Chicago to whom, of course, it has always belonged.

It seemed to both of us that the occasion of the fiftieth anniversary was the logical time to announce the change. Accordingly, the matter has been fully discussed with the Board of Trustees, has met with their unanimous approval, and they have authorized me to make this announcement to you.

The change will become effective as soon as legally possible.

THE NATIONAL METAL CONGRESS

A SERIES of seventeen practical sessions on production, conservation and post-war planning in the metal industry have been announced by W. H. Eisenman, national secretary of the American Society for Metals, for presentation during the National Metal Congress and War Conference Displays in the Palmer House, Chicago, during the week of October 18. These sessions will provide a central clearing house for the practical solution of production problems, of conservation demands and of many post-war problems.

There will be a session on Wednesday afternoon, October 20, on Post-War Planning in the Non-ferrous Metals. A discussion on Thursday afternoon, October 21, will concern fundamental changes that may reasonably be expected in metallurgy and metals generally. On the same afternoon, a simultaneous session will deal with light-weight construction for the post-war era.

The seventeen sessions will open on the afternoon

f October 18, with a discussion of advanced quench-g practice. The purchase of steels on expected per-ormance which is the European practice rather than n chemical analysis, as used in this country, will be onsidered at one of the evening sessions on Monday, ith the other simultaneous sessions devoted to non-estructive tests. Powder metals, products that have eally come into their own during the war, will be dis-ussed on Tuesday afternoon, October 19. Simul-aneous sessions the same afternoon will deal with pecial alloy addition agents for steel, with another ession on steel-making methods scheduled for Tues-ay evening. Another Tuesday afternoon session will e on foundry metallurgy.

On Wednesday afternoon, October 20, in addition o the session on post-war planning in non-ferrous metals, a simultaneous session will take up modern practices in surface hardening. Another session on Wednesday afternoon will deal with control of quality by inspection. This session will also take up the per-sonal equation in inspection, precision measurements nd the statistical analysis of test results. A ses-sion in the afternoon will deal with control of qual-ity by inspection. National emergency steels will occupy the session in the evening. Use of these new steels in aircraft and engines, as well as their general utility, will be discussed.

Salvaging metals, including the recovery of battle-field scrap, will be discussed in one of the simultaneous sessions on Thursday afternoon, October 21.

Magnesium and magnesium alloys will be the sub-ject of one of the final sessions on Friday afternoon, October 22. "The Working of Magnesium," a film of the Dow Chemical Company, will be shown. The other session will deal with special finishes and metal-lic protection.

War production sessions will be held each afternoon and evening during the week, except Thursday and Friday evenings, in the Palmer House, where more than one hundred and sixty manufacturers will have war conference displays. The technical and profes-sional programs of the society will be held each morn-ing.

THE LOUIS LIVINGSTON SEAMAN FUND

THE New York Academy of Medicine announces the availability of the Louis Livingston Seaman Fund for the furtherance of research in bacteriology and sani-tary science. One thousand dollars is available for assignment in 1943. This fund has been made pos-sible by the terms of the will of the late Dr. Louis Livingston Seaman, and is administered by a commit-tee of the academy under the following conditions and regulations:

(1) The committee will receive applications either from institutions or individuals up to November 1, 1943. Communications should be addressed to Dr. Wilson G. Smillie, chairman of the Louis Livingston Seaman Fund, 1300 York Avenue, New York City.

(2) The fund will be expended only in grants-in-aid for investigation or scholarships for research in bacteriology or sanitary science. The expenditures may be made for: (a) Securing of technical help. (b) Aid in publishing original work. (c) Purchase of necessary books or apparatus.

NEED FOR WATER-INSOLUBLE FORMS OF WATER-SOLUBLE VITAMINS

THE practicable enrichment of corn grits and white rice with certain vitamins would be greatly facilitated if insoluble forms of thiamine, riboflavin and niacin were available. Whereas the soluble forms of these factors are entirely suitable for the enrichment of white flour and of many of the cereal breakfast foods, the customary culinary methods widely prevalent in this country make these water-soluble forms less suitable. Corn grits and white rice, for example, are often subjected to rinsing before cooking. Thus water-soluble vitamins sprayed on the exterior surfaces of these particles would be washed off and lost in the discarded rinse water. In the face of this situation methods are in process of development for impregnating the water-soluble vitamins within the interior of special granules of size and texture approximately comparable to the hominy grits or white rice, respectively, but that method has certain disadvantages.

Cognizant of the importance of this situation, the Committee on Cereals and the Food and Nutrition Board of the National Research Council at their meeting on September 1, 1943, made the following proposal:

The food and nutrition board commends to the attention of laboratories of the chemical and cereal industries and to those of universities and experiment stations the desirability of developing insoluble salts or derivatives of thiamine, riboflavin and niacin, capable of being fixed upon the surfaces of cereal particles in physiologically active form and in a manner to avoid loss by rinsing. Such developments would be of peculiar value in the enrichment of white rice and corn grits.

FRANK L. GUNDERSON,
Executive Secretary

FOOD AND NUTRITION BOARD,
NATIONAL RESEARCH COUNCIL,
WASHINGTON, 25, D. C.

SCIENTIFIC NOTES AND NEWS

CORNELIUS FRANCIS KELLEY, chairman of the board of directors of the Anaconda Copper Mining Company, has been awarded the Charles F. Rand Memorial Medal for "distinguished achievement in mining administration" by the American Institute of Mining and Metallurgical Engineers. Presentation of the medal will take place at the annual dinner meeting on February 22, 1944.

A TESTIMONIAL dinner in honor of Major General James C. Magee, whose term of office as Surgeon General of the Army expired on May 31, was given at the Statler Hotel in Washington, on May 25. About two hundred and fifty officers of the medical department attended.

DR. E. B. FRED, for thirty years a member of the department of agricultural bacteriology of the University of Wisconsin and for the past nine years dean of the Graduate School, has been appointed dean of the College of Agriculture.

DR. JOHN H. FERGUSON, of the department of pharmacology of the School of Medicine of the University of Michigan, has been appointed professor and head of the department of physiology of the School of Medicine of the University of North Carolina. Dr. Ferguson is known for his research on the mechanism of blood clotting.

DR. ROBERT J. MASTERS has been appointed professor and head of the department of ophthalmology at the School of Medicine of Indiana University. Dr. William F. Hughes, who since 1934 has been chairman of the department, will continue teaching.

DRS. HOWARD W. POTTER, clinical professor of neurology and psychiatry, and Nicholas B. Dreyer, associate professor of pharmacology, have been promoted to full professorships at Long Island College of Medicine, Brooklyn.

DR. RICHARD H. LOGSDON, formerly librarian and head of the department of library science at Madison College, Harrisonburg, Va., has been appointed head of the department of library science at the University of Kentucky.

DR. LEWIS F. STEIG, since 1936 librarian of Hamilton College, has been appointed assistant director of the Library School of the University of Illinois.

COLONEL BRADLEY DEWEY, of Cambridge, Mass., who was recently appointed acting rubber director of the War Production Board, has been named national rubber director. He succeeds William M. Jeffers.

EDWARD M. COLLINS, who has been on leave of absence for a year from Kent State University to teach at Williams College, has been appointed professor and head of the department of chemistry at Illinois College, Jacksonville.

DR. E. J. WELLHAUSEN, associate professor of agronomy in the department of agronomy and genetics of West Virginia University and associate geneticist of the Agricultural Experiment Station, has joined the staff of the Rockefeller Foundation in Mexico City.

DR. ROBERTS A. HEARN, since 1936 director of industrial hygiene of the Kansas State Board of Health, has become medical director of the Indiana Division of the Republic Aviation Corporation.

WILLIAM B. MURPHY has been appointed deputy vice-chairman for production of the War Production Board. He will direct all production activities within the industry divisions and bureaus which report to the vice-chairman of the Office of Operations. Turner E. Currens has retired as chief of the Botanicals Unit of the Drugs and Cosmetics Section of the Chemical Division. He is succeeded by Henry W. Heinie. Garfield R. McDonald, of Cleveland, has been made assistant director of the Textile, Clothing and Leather Division.

ROBERT E. ALLEN has resigned as assistant deputy petroleum administrator of the Petroleum Administration for War, to become director of the Department of Information of the American Petroleum Institute, New York.

IT is reported in *Chemical and Engineering News* that Harry A. Campbell, who for thirty-four years has been associated with the Bureau of Explosives, has been appointed chief inspector.

THE *Journal* of the American Medical Association reports that the committee on the teaching of tropical medicine of the Association of American Medical Colleges has arranged that Dr. Donald B. McMullen, associate professor and head of the department of hygiene and public health and associate professor of bacteriology of the School of Medicine of the University of Oklahoma, should go to Central America during the month of September to observe methods of tropical disease control. He planned to spend about three weeks at a United Fruit Company hospital and at least a week with the local field unit of the Office of the Coordinator of Inter-American Affairs.

DR. R. S. CAMPBELL, since 1934 assistant chief of range research of the Forest Service, U. S. Department of Agriculture, will take charge of a new re-

search project concerning problems of grazing on forest lands at the Southern Forest Experiment Station. These studies, to be conducted by the Forest Service in cooperation with the Louisiana Agricultural Experiment Station, were authorized by the Congress in the Agricultural Appropriation Act for the current fiscal year. The first step is to be a survey primarily of beef cattle grazing in the forests of Louisiana. Emphasis will be given to farms where livestock are grazed on forest lands as a major enterprise rather than incidentally. The survey is expected to bring out ways of coordinating forest grazing with the use of farm pasture and other feed and to indicate improved forest-grazing practices. The survey also will show the important problems of stockmen and other agencies so as to work out and apply improved management practices of forest grazing. It is believed that wartime production of meat, hides and wool can be increased considerably in Louisiana by better grazing management. There are sixteen million acres of forest land.

THE department of mechanical engineering of Bucknell University has been named "The George T. Ladd Department of Mechanical Engineering" in honor of George T. Ladd, a Pittsburgh industrialist who has been a trustee of the university for several years.

A LIBERTY ship launched at Baltimore on September 13 was named for Henry Lomb, of the Bausch and Lomb Optical Company, who with John Jacob Bausch established the company in 1853.

A SERIES of five lecture-demonstrations on the cause, prevention and cure of various diseases will be offered for teachers at the American Museum of Natural History on Friday evenings at 8 o'clock, beginning on October 2. The lectures will be given by specialists under the auspices of the New York Association of Biology Teachers. The program, together with the names of the lecturers, follows: October 2—"The Problem of Cancer," by Dr. Halsey Bagg. November 5—"The Problem of Syphilis," by Dr. William Bayard Long. December 3—"The Problem of Tuberculosis," by Dr. Grant Thorburn. March 3—"The Problem of Emotional Disturbances of Youth," by Dr. Marion Kenworthy. May 5—"The Problem of Certain Diseases of the Circulatory System," by Dr. William Goldring.

THE first Inter-American Congress of Radiology will be held in Buenos Aires from October 17 to 22, under the auspices of the Argentine Society of Radiology.

THE *Journal* of the American Medical Association states that competitive essays for the Warren Triennial Prize will be received until November 15. The prize was set up in a fund by the late Dr. J. Mason Warren in honor of his father, Dr. John C. Warren. The accumulated interest is awarded every three years to the best dissertation considered worthy of a premium on some subject in physiology, surgery or pathologic anatomy, the arbitrators being the general executive committee of the Massachusetts General Hospital.

THE daily press reports that thirty scholarships for study in Great Britain are being offered by the committee in charge of the British Boxer Indemnity Fund. Competitive examinations will be held on February 1, 1944, at Chungking, Sian, Chengtu, Kunming, Kweilin and Taiho. Scholarships will be for students in physics, mathematics, mechanical engineering, hydraulic engineering, aeronautical engineering, mining engineering, forestry, pharmacology, public health, economics, law, education and naval architecture.

The New York Times reports that an all-radio industry planning board was formed in New York City on September 16 to guide the efficient and orderly progress of radio and electronics after the war. Representatives of nine outstanding industries of the country announced that a tentative plan had been approved unanimously. These are the Institute of Radio Engineers, the American Institute of Electrical Engineers, the Radio Manufacturers Association, the American Institute of Physics, the American Radio Relay League, FM Broadcasters, Inc., the International Association of Chiefs of Police, the National Association of Broadcasters and National Independent Broadcasters. For the first time a supervisory body has been formed designed to avoid chaos in radio-electronic post-war reconstruction. Operations will begin on September 29, at which time various engineering groups will be set up to undertake definite projects. Any technical project allied with radio and broadcasting will come under the advisory supervision of the board.

The New York Times also reports that William L. Batt, vice-chairman of the War Production Board, American member of the Combined Raw Materials Board, has announced the organization of a combined conservation committee, the American counterpart of the Anglo-American Conservation Committee set up in London last February. The purpose of the combined committee is to correlate the conservation work done in Great Britain and the United States by the active interchange of information in regard to conservation measures developed here, in Canada and in the United Kingdom. Howard Coonley, director of the conservation division of the War Production Board, has been named chairman of the combined committee, and a deputy chairman is to be appointed by the British members of the Combined Production and Resources Board and the Combined Raw Materials

Board. The work of the committee will be concerned with savings through simplification, standardization and the use of alternative materials.

IN accordance with a reorganization plan all dairy research will be centered at the New York State College of Agriculture at Ithaca, and the program at the Experiment Station at Geneva will be developed along the lines of horticultural research and related fields.

THE Cutter Laboratories at Oakland, Calif., have arranged to erect a new plant for the production of penicillin.

ACCORDING to the daily press, in order to assist in meeting the shortage of technical help in many of the war plants of the State of New Jersey, Rutgers University is sending instructors directly into factories to conduct in-service training classes. The courses are tuition free. Workers are saved the time which otherwise they would have to spend commuting between factory and school. This will not interfere with the operation of the university's public war-training centers where general instruction will be carried on in engineering, science and management. A similar plan is being put into effect by the Manhattan College School of Engineering, New York City.

THE *Journal* of the American Medical Association reports that the Faculty of Medical Sciences of Buenos Aires recently opened its new building, occupying a whole block. It consists of twenty floors and will house the faculties of medicine, biochemistry, pharmacology, odontology, the Institute of Pathologic Anatomy, the Pardo Maternity Hospital and the Pavilion for tabetic patients.

DISCUSSION

TWENTY-FIVE-YEAR EFFORT AT SAVING NATURE FOR SCIENTIFIC PURPOSES

NEARLY all interests excepting that of natural science are organized so as to exert pressure upon legislative and executive bodies when there are conflicting interests relative to land use. There are in North America, north of Mexico, more than five hundred local and national scientific biological organizations, most of which under ordinary circumstances are committed to saving of samples of biotic communities or samples of vegetation for the scientific use of present and future generations. It is evident that, if some kind of union of these interested forces could be brought about, a great many movements detrimental to the interests of science and humanity might be checked or retarded. Likewise movements beneficial to science could be accelerated through the influence of a united effort. The writer was appointed chairman of a committee in the Ecological Society of America in March, 1917, and served until 1938. This committee was charged with the listing of natural areas suitable for preservation. This proved to be the beginning of an effort to organize the scientific interests of the United States and Canada for the purpose of preserving nature. The list of natural areas, with related material, was published in 1925 as *The Naturalists' Guide to the Americas*. The closing out of the remaining copies of this publication by the publisher early in 1942 marked the twenty-fifth year of experience with the problems concerned.

An effective type of organization was brought about and has operated successfully for about sixteen years. Experience has shown that two types of committee are essential: (1) A Study Committee to inquire into the use and disposal of lands which included natural biotic communities, and (2) a Public Contact Committee to urge governmental agencies to act in certain ways. This one can include no employees of the national government. The second committee would be responsible not only for exerting pressure but also for organizing the pressure of the affiliated local societies and national organizations. Such an organized effort was successful in bringing about the establishment of the Glacier Bay National Monument in Alaska. In this case, application was made to the executive department of the United States Government and was said at the time to be one of the most unified demonstrations ever experienced by the officials concerned. There were other partially successful efforts to prevent the despoliation of national parks, monuments, etc.

The organization of the Public Contact Committee included two or more representatives in each political division (states, etc.) to provide an annual list of officers of local organization in their territory. The officers of the organizations changed and they frequently have not understood what they were expected to do and frequently lost interest. Of course the state representatives of the committee who were called upon to report did not always succeed in giving the information. These difficulties were the exceptions and were not at all prevalent. The expense of the committee operation has at all times been considerable and down to 1937, only 29 per cent. of it was paid by the society, even though some contributions of institutions where the committee officers were housed were not included in the total. A considerable part of the expense was provided by contributions of the interested societies who were a part of the organization.

A report, however, was sent to each contributing

society showing what had been attempted and accomplished during the preceding year. The local and contributing societies were appreciative of such publications and reprints as could be supplied from time to time, but there was no regular publication, a fact which interfered with the payment of contributions for the work. In spite of difficulties, it has been demonstrated that it is clearly possible to make the local scientific bodies into an effective force. What appears to be needed is some means of keeping them in contact with the central committee.

In spite of the fact that the majority of members are interested, the Ecological Society of America has not yet developed sufficient interest to put this or any other plan on a permanent workable basis. At the end of the twenty-five-year period, the project is probably no better established than at the end of the first nine years, when the machinery was first put to work in the case of the Glacier Bay National Monument. With the wartime and post-war pressure to destroy nature already mounting, it is well for those interested in its preservation for scientific purposes to look over the machinery by which some of it may possibly be saved.

V. E. SHELFORD

UNIVERSITY OF ILLINOIS

ON METHODS OF "STARRING" AMERICAN MEN OF SCIENCE

THE recent discussions in SCIENCE regarding the practice of "starring" deserving men of American science seem to have missed the crux of the problem. The question of the usefulness or fairness of such a practice depends entirely upon the accuracy of the method by which the desired end is attained. If it gives predominating chances of selection to certain scientists with the exclusion of others equally worthy of consideration a serious injustice is done and the value of the practice of "starring" is correspondingly decreased. That the present method of "starring" affords a very unfavorable opportunity of selection for many deserving men can be very easily proved.

Forty-two research institutions are represented on a recent list of 82 chemists, nominated for inclusion among the 175 leading chemists of America, from which list 44 are to be selected for "starring" in the seventh edition of the Biographical Directory of American Men of Science. These institutions, with the number of nominees belonging to each, are indicated in the accompanying list.

Massachusetts Institute of Technology	8	Brooklyn Polytech.	1
Illinois	7	Rockefeller Inst.	1
Wisconsin	5	Cal. Inst. Tech.	1
Pa. State Col.	4	Monsanto Chem. Co.	1
California	4	Conn. Agr. Expt. Sta.	1
Columbia	4	Gen. Aniline Co.	1
Michigan	3	U. S. Dept. Agr.	1
Northwestern	3	New Eng. Ind. Research Foundation	1
Chicago	3	Shell Develop. Co.	1
Stanford	2	Missouri	1
Minnesota	2	Rohm and Haas Co.	1
Princeton	2	Bell Tel. Labs.	1
Ohio State	2	Ethyl Gas Corp.	1
Merck and Co.	2	Brown	1
Nat. Bur. Standards	2	Calco Chem. Co.	1
Pennsylvania	2	Cornell	1
Harvard	2	Harvard Med.	1
Pittsburgh	1	Esso Labs.	1
Purdue	1	U. S. Rubber Co.	1
Distill. Products	1	Nebraska	1
Eastman Kodak	1		
U. S. Bur. Mines	1		82

A few questions that every thoughtful recipient of this list might ask are: (1) What plan of nominations was adopted that gave Massachusetts Institute of Technology 8 times as many nominees for starring as the California Institute of Technology or any of the other 24 institutions having only 1 nominee? Is this proportion based upon number or productivity of research staff? (2) How does it happen that Yale, Johns Hopkins, Mellon Institute of Industrial Research and scores of other important chemical research institutions are not represented? (3) Has chemical research fallen so low in the institutions not mentioned on this list that they have no candidates worthy of being starred? Such a conclusion is too unreasonable to be considered. (4) Has general interest in the practice of starring men of science become so slight that many directors of research are indifferent about it and do not take the trouble to sponsor candidates? This is perhaps one explanation for the very unbalanced list of "starrable" chemists now being submitted.

Whether the situation as regards chemistry exists also in the lists of nominees for other sciences the writer has no means of knowing. If the same conditions prevail generally then the present system of selecting "stars" for inclusion in the Directory of American Men of Science is of little value and might just as well be discontinued.

There is nothing so fallible as human judgment and if the practice of starring men of science is to be continued it should be based upon purely impersonal methods of selection which are free from the faults of indifference, favoritism, etc., that give rise to unfair representation. Impersonal methods are in fact the only means of enabling a voter to make a selection from a long list of candidates of whom the majority are unknown to him. Among such impersonal criteria may be mentioned numbers of papers published in a given period of years, numbers of patents taken out, rank of position, offices held in scientific societies, honors awarded, etc. Each one of these methods has

certain limitations, yet when considered together on a rating sheet the combined weighted average is as accurate as can be achieved by statistical methods of evaluation, and it is vastly superior to the result obtained by the common method of marking a long ballot upon the basis of personal acquaintance or of solicitation.

The author has compiled lists of selected chemists for his personal use from the decennial author indexes of *Chemical Abstracts*. If for this ten-year period a chemist shows a productivity, as author or coauthor, of over 20 papers, his name is added to a preliminary list to which other criteria are then applied. A preliminary list thus compiled includes deserving names that are not included on the list of chemists submitted by the editor of the new Directory of American Men of Science. It is open to the objection that an index of papers includes many items of trivial scientific importance, but it has its use as a rough rapid sorting-out method which can be combined with the results of other criteria, according to the purpose of the compilation.

Because of the frequency with which the Directory of American Men of Science is consulted and of the high regard in which it is held, it is most desirable that its method of "starring," in order to avoid the injustice of overlooking worthy candidates, be based upon impersonal methods of the highest attainable accuracy.

C. A. BROWNE

U. S. DEPARTMENT OF AGRICULTURE

CLAVACIN AND THE PRESS

RECENTLY a press article appeared in many newspapers concerning the work done in this laboratory on clavacin, an antibiotic substance obtained by *Aspergillus clavatus*. The release given to the local press was so worded as to emphasize the fact that this material was being tested against *plant pathogenic bacteria*, and full credit was given Dr. S. A. Waksman, of the New Jersey Agricultural Experiment Station, and his associates for their discovery and pioneer work on clavacin. It was compared with penicillin, and the statement was made that clavacin was more bactericidal for *some species of bacteria* than was penicillin. Due to the wide publicity given penicillin, this statement attracted the attention of the outside press, and unfortunately resulted in decidedly misleading statements regarding the possibility of clavacin as a powerful new remedy for human diseases. Furthermore, some of the abbreviated articles made no mention of the previous work of Dr. Waksman and his associates.

The work done in this laboratory has been concerned primarily with the testing of clavacin-containing filtrates on bacterial plant pathogens. This research was undertaken as a result of the publication by Waksman, Horning and Spencer (SCIENCE, 96: 202-203, 1942) indicating that *Aspergillus clavatus* produced a bactericidal substance which was effective against both gram-positive and gram-negative organisms and, furthermore, its action was bactericidal as well as bacteriostatic. Since most species of bacteria causing plant diseases are gram-negative we reasoned that clavacin might be more useful in the control of plant pathogens than any of the many other mycogenous bactericides which had been described.

Dr. Waksman kindly furnished me a strain of *Aspergillus clavatus* which he had found to be very active in the production of the bactericidal substance. Using the media and the technic he suggested, we were able to obtain a material which gave similar results to those obtained by Dr. Waksman when tested against *Staphylococcus aureus*, the test organism used by most investigators. Using the unconcentrated, sterile filtrate, a series of tests were run against over twenty species of phytopathogenic bacteria. The detailed results and methods used will be published in full at a later date. In general, bacteriostatic action was observed in all cases at fairly low concentrations, while bactericidal action varied greatly. A comparison of *Staphylococcus aureus* with *Phytomonas pruni* indicated that the latter could be used as a standard organism for plant pathogens, since the lethal dose was about the same for these two organisms.

Comparisons of penicillin and clavacin were made on some of the plant pathogens, in each case using the unconcentrated filtrate from *Penicillium notatum* and *Aspergillus clavatus*. The *Penicillium notatum* culture was one known to produce a high yield of penicillin and the filtrate was standardized with *Staphylococcus aureus* as the test organism. The *Penicillium notatum* filtrate failed to show any decided bactericidal action against a number of the phytopathogenic species, whereas the Aspergillus filtrate showed its usual potency.

It is to be regretted that this comparison of clavacin and penicillin, when reported in the press, resulted in a flood of letters from people suffering from all kinds of diseases, whose hopes had been raised by the results obtained from penicillin and the wide publicity given this new "miracle drug." Dr. Waksman has stated that clavacin is quite toxic to animals and, certainly in its present form, is not likely to be a rival of penicillin or the sulfa drugs. It should be recalled, however, that penicillin was reported as "toxic" when injected into animal tissues before it was highly purified.

H. W. ANDERSON

DEPARTMENT OF HORTICULTURE,
UNIVERSITY OF ILLINOIS

SCIENTIFIC BOOKS

BLOOD GROUPS AND TRANSFUSION

Blood Groups and Transfusion. By A. S. WIENER. Charles C Thomas. 1943.

THIS is the third edition of a book which has become the best known and most popular in its field. The author is one of the most eminent of present-day workers in blood grouping. While there are a good many persons in this country with wide experience in blood transfusion, and a number with intimate acquaintance with serological techniques as applied to blood grouping, Dr. Wiener is one of the few who is qualified to write as an authority on both fields, and the result is a book of unique usefulness. It is so written that it may be used immediately by those not previously acquainted with the subject, but it is at the same time quite complete, so that there will be few owners of it who will need to seek more complete treatises, of which in fact there are none which are at all up to date. Those sections which may be of interest only to specialists are given in small print and may be omitted by the beginner without loss of continuity. The reader who desires more detailed information will progress in nearly every case directly to the current periodical literature.

The last three years have witnessed a marked increase of interest in the fields of blood transfusion and blood grouping, owing not only to the outbreak of the war, but also to the widespread adoption of "blood banks" in civilian hospitals and to a much greater use of fresh and dried plasma and other blood substitutes. At the same time it is gradually coming to be realized in technical laboratories that blood grouping is not a casual affair to be entrusted to the untrained intern or technician, but a very important operation, upon the successful performance of which may depend the life of a patient. In addition, the increasing recognition that the subgroups, and in particular the blood factor known as Rh, may, and often do, play a role in transfusion incompatibilities, has made it essential that those who undertake to direct blood grouping be equipped with rather more specialized knowledge than is possessed by the average medical man. The role of Rh in erythroblastosis fetalis has also contributed to the change. Hundreds of new articles on these subjects have appeared since the second edition of this book, and Dr. Wiener has ably attempted to enlarge and bring the volume up to date.

The general intention of the book is to summarize the present knowledge concerning the theory and technique of blood grouping; to present the applications to clinical, legal and veterinary medicine, and in anthropology, and to assemble and integrate the essential facts concerning the transfusion of whole blood, plasma and serum. There are 22 chapters; two introductory chapters dealing with the general facts about the blood groups, one on sources of error in blood grouping, one on the history of transfusion, one on the selection of donors, three dealing with transfusion, a chapter on fundamental genetic principles and chapters on the heredity of the groups, subgroups and M, N types. The subgroups and other individual blood differences are discussed in separate chapters, as is the Rh factor. The occurrence of the group substances in organs and body fluids, the evolution of the blood groups, the relation to disease, all have their chapters, as do the forensic applications to disputed parentage and the grouping of blood stains. The applications to anthropology are also discussed in a separate chapter which contains considerable data in tabular form.

The book contains 438 pages, 132 more than the second edition. Part of the additional material is comprised in the two new chapters, one dealing with the transfusion of stored blood and blood substitutes and the other with the recently discovered Rh factor and its role in erythroblastosis fetalis. Most of the new material, however, is in the form of additions to original chapters, some of which have been almost completely rewritten. The chapters on transfusion have been improved by the inclusion of some new illustrations which are greatly superior to those of former editions. The anthropological chapter has been enlarged by the inclusion of new tabular data and illustrations showing certain salient features of the world distribution of the blood-grouping factors. Newer and more specialized techniques, such as the determination of blood groups from mummified material and from bones, are also discussed briefly.

The most useful features of the book are probably the clear expositions of the fundamental principles and the basis for division of blood into groups and subgroups and the descriptions of the technique of performing such tests, together with the very clear and detailed descriptions of transfusion technique and the indications for and results of transfusions. Particularly notable is the detailed discussion of the new Rh factor and methods of detecting it. Second only to these sections are the discussions of the heredity of the various groups and types and the application of this knowledge to forensic medicine and other fields. The discussion of individual blood differences in animals is also very good.

Possibly the least satisfactory chapter, in the opinion of the reviewer, is that on the anthropological applications. For, although the data presented in the

tables are a good selection and are up to date, the discussion in the text is still too closely modeled on that of the first edition, which was written when many important facts were yet unknown and the significance of certain of the older data was still unappreciated. In particular there are several paragraphs, tables and graphs which might lead the unwary reader to suppose—falsely, I think—that Dr. Wiener holds the now abandoned theory that all American Indians, before white contact, possessed only blood group O. The data of Rahm, Golden, Matson and Schrader, and the calculations of Wyman and Boyd, which combined to render this theory untenable, are however referred to, and one may feel sure that the imperfection will be corrected in future editions.

The book is characterized by very complete references to the literature, in the form of footnotes to the text, as well as a bibliography of works of general reference. There is a very excellent subject index. Typography and format are of the same high quality as in previous editions, and the paper and binding appear to be excellent.

WM. C. BOYD

BOSTON UNIVERSITY SCHOOL OF MEDICINE

CHEMISTRY

Physical Chemistry. By FRANK H. MACDOUGALL. Revised edition. 709 pp. New York: The Macmillan Company. 1943. $4.25.

THE good reception of the first edition (1936) of this text-book has led to the publication of its second edition (see preface). One who is familiar with the first edition will find the second almost unchanged, for "the author has not considered it necessary to make many substantial changes in the material discussed or in the manner of treatment." In particular, many will be glad to see that the large section devoted to chemical equilibrium has been retained without an alteration.

The principal revisions are the following: The table of natural isotopes has been brought up to date, the table of standard E.M.F.'s has been enlarged, three pages on liquid crystals and glasses have been added, the section on artificial radioactivity has been rewritten, one page on the glass electrode has been added, and the derivation of the Gibbs adsorption equation has been made more rigorous.

Several smaller improvements have been made. Equation II–(11) and Equation VII–(20), which contained errors in the first edition, have been corrected. Three problems have been added. The symbol E has been used instead of U for the energy of a system, so the text now follows the Lewis and Randall notation used by most American thermodynamics texts (including that of the author). The numerical values of the general physical constants have been brought more nearly up to date, though those given do not agree with Birge's latest (1941) values.

Since so few major revisions have been made in the text, several deserving topics have been given no more space in the second edition than they had in the first. For example, quantum mechanics has not been treated at any great length, while the theory of reaction rates has been omitted entirely. It is to be hoped that the author will devote additional space to some of these topics in future revisions.

It is disappointing to see that the old bombardment theory of osmotic pressure has been retained.

The decomposition of N_2O as an example of a second order reaction (p. 415 and Problem 7 on p. 446) should be abandoned, since experimental work more recent than that cited in the text has shown the reaction to be of 3/2 order (*cf.* Pease, "Equilibrium and Kinetics of Gas Reactions," Princeton University Press, 1942, pp. 129–134). In fact, a portion of the chapter on kinetics might well be devoted to 3/2 order reactions.

If the old equation of Bodenstein and Fink for the kinetics of oxidation of SO_2 on platinum is quoted, mention should also be made of the recent and much more satisfactory equation of Uyehara and Watson.[1]

These few omissions do not, of course, seriously impair the value of the book. The first edition was, and the revised edition remains, a well-written and useful text-book for beginning physical chemistry.

R. E. POWELL

PRINCETON UNIVERSITY

SPECIAL ARTICLES

THE SEROLOGICAL ACTIVITY OF DENATURED ANTIBODIES[1,2]

As a logical sequence to recent investigations on the effects of regeneration on the antigenic activity of serum albumin,[3,4] we have studied the influence of denaturation and regeneration on the immunolgical functions of antibodies.

The source of antibody was a concentrate of diva-

[1] This work was supported by the Rockefeller Foundation and by the Lederle Laboratories, Inc.

[2] Taken from a thesis to be presented by J. O. Erickson to the Graduate School of Arts and Sciences of Duke University, in partial fulfilment of the requirements for the degree of doctor of philosophy.

[1] *Ind. Eng. Chem.*, 35: 541, 1943.

[3] J. O. Erickson and H. Neurath, *Jour. Exp. Med.*, 78: 1, 1943.

[4] D. S. Martin, J. O. Erickson, F. W. Putnam and H. Neurath, *Jour. Gen. Physiol.*, 26: 533, 1943.

lent types I and II antipneumococcus horse serum, obtained through the courtesy of the Lederle Laboratories, Inc. Over 80 per cent. specifically precipitable antibody of type I was isolated by successive precipitations with SSS I in the antibody excess region, and subsequent dissociation of the specific precipitate with 15 per cent. NaCl solution.[5,6] Guanidine hydrochloride, whose action on normal horse serum globulin, GI, has previously been studied,[7] was used as a denaturing agent.

Irreversibly denatured and regenerated antibody were prepared by treatment of a 2 per cent. solution of the native antibody with 8 M guanidine hydrochloride, removal of the denaturing agent by dialysis and separation of the irreversibly denatured fraction by isoelectric precipitation.[7] The regenerated protein, remaining in the supernatant solution, was readily soluble in water and in physiological saline; the highly insoluble irreversibly denatured protein could be dissolved in 2 per cent. NaCNS in saline, to the extent of about 0.3 mg of protein N per ml, at pH 6.5.

After it was found that all fractions were specifically precipitable by the homologous antigen (SSS I), quantitative precipitin titrations were performed, using the method of Heidelberger and Kendall.[8] Comparison of the serological activity of native and regenerated antibody was made in physiological saline solutions, that of native and irreversibly denatured antibody in 0.9 per cent. solutions of NaCl containing also 2 per cent. NaCNS. Representative data relating to the equivalent combining ratios of mg antibody N to mg antigen, R, and to the per cent. of specifically precipitable antibody nitrogen, N, are given in Table 1.

TABLE 1

Preparation	Solvent	R	Per cent. antibody N specifically precipitable
Native antibody ..	0.9 per cent. NaCl	3.3	80
Native antibody ..	0.9 per cent. NaCl + 2 per cent. NaCNS	2.9	37
Irreversibly denatured antibody .	0.9 per cent. NaCl + 2 per cent. NaCNS	1.3	50–60
Regenerated antibody	0.9 per cent. NaCl	6.0	70

The data reveal no significant difference in the equivalent combining ratio of native antibody in saline and in the presence of NaCNS. When the supernatant of the specific precipitate, obtained at the equivalence point in the presence of NaCNS, was dialyzed against saline, no additional precipitation occurred unless more antigen was added, indicating that NaCNS had shifted the equilibrium between antigen and antibody rather than inhibited the precipitation of the antigen-antibody complex.

The difference in combining ratio between native, irreversibly denatured and regenerated antibody may be ascribed either to a change in effective antibody valence or else to changes in their molecular dimensions, as they have been found to occur when normal horse serum globulin GI is treated with concentrated solutions of guanidine hydrochloride. Molecular weight studies on these fractions are under way.

It is of considerable significance that the denatured and regenerated antibody were serologically active, and the general theoretical and practical aspects of this finding will be discussed elsewhere.

The fact that the regenerated antibody is nearly as fully precipitable by the homologous antigen (70 per cent.) as the native (80 per cent.), and the irreversibly denatured material even more so, when measured under comparable external conditions (50 to 60 per cent. as compared to 37 per cent.), suggests that, contrary to Pauling's hypothesis,[9] the difference between antibody globulin and normal globulin is not merely one of steric arrangement but probably one of amino acid composition. If denaturation of normal serum globulin, followed by regeneration in the presence of an antigen, should give rise to a fraction of a material possessing antibody activity,[10] then, conversely, regeneration of a denatured antibody in the absence of the specific antigen should, in keeping with that hypothesis, yield a material essentially devoid of serological activity. This, however, is not the case.

It remains to be seen whether the denatured and regenerated antibodies are effective in animal protection; requisite experiments are under way. Experiments on the relative antigenic activities of these fractions and on their antigenic relation to native and denatured normal serum globulins will be reported elsewhere.

JOHN O. ERICKSON
HANS NEURATH

DEPARTMENT OF BIOCHEMISTRY,
SCHOOL OF MEDICINE,
DUKE UNIVERSITY

PROTECTIVE EFFECT OF SEPARATE INOCULATION OF SPOTTED FEVER VIRUS AND IMMUNE SERUM BY INTRADERMAL ROUTE

THE purpose of the present work is to investigate the possibility of protecting a susceptible animal against spotted fever by using minute doses of specific

[5] B. F. Chow and H. Wu, *Chinese Jour. of Physiol.*, 11: 161, 1937.
[6] M. Heidelberger and F. E. Kendall, *Jour. Exp. Med.*, 64: 161, 1936.
[7] H. Neurath, G. R. Cooper and J. O. Erickson, *Jour. Biol. Chem.*, 142: 265, 1941.
[8] M. Heidelberger and F. E. Kendall, *Jour. Exp. Med.*, 61: 559, 563, 1935.
[9] L. Pauling, *Jour. Am. Chem. Soc.*, 62: 2643, 1940.
[10] L. Pauling and D. H. Campbell, *Jour. Exp. Med.*, 76: 211, 1942.

rabbit hyper-immune serum. The immune serum was produced by repeated inoculations of rabbits with both spotted fever vaccine and the virus.[1] The intradermal route of inoculating guinea pigs with virus and serum was used.

Our study is based on the known phenomenon in which the infiltration of the skin in susceptible animals with specific immune serum affords protection against subsequent inoculation with the homologous virus of vaccinia.[2, 3, 4]

Three main factors were considered: the site of inoculation, the time factor and the amount of immune serum.

An area of ¼ square inch of guinea pigs' skin was infiltrated first with 0.4 cc of immune serum, and then two hours later 0.1 cc of virus was injected into this area. These animals remained afebrile and proved immune to subsequent reinfection with spotted fever.

Fifteen guinea pigs were then treated with 0.1 cc of virus and 0.4 cc immune serum simultaneously at the same site. No fever was noted in eleven of them, while four developed spotted fever. Only three of the non-reacting animals showed solid immunity to subsequent reinfection with spotted fever. Of six other guinea pigs injected with virus and serum as above but at *different sites* of the body, five developed typical spotted fever.

In the next series of thirteen guinea pigs smaller amounts of immune serum were used: 0.1 cc, 0.05 cc and 0.025 cc, the serum and 0.1 cc of virus given simultaneously and at the same site. Of these none developed spotted fever. Four weeks later they were all reinfected with a five-fold dose of virus and nine animals showed complete immunity in striking contrast with the control animals.

Inactivation of the virus in the skin was followed by solid immunity even when 0.025 cc of immune serum was injected at the same site and as long as 18 hours following the virus injection. Experiments are now under way to find out the lapse of time subsequent to virus inoculation after which immune serum will still protect the animal.

It is hard to believe that the negligible amount of 0.025 cc of immune serum could afford any degree of passive immunity. We may presume, however, that the virus absorbed by the highly potent anti-serum in the tissue acted as a sensitized vaccine. It is also possible that this amount of serum was not able to neutralize the virus completely, leaving a fraction of the virus to escape. Nevertheless, this negligible quantity of free virus would contribute to the protection of guinea pigs against the reinfection and thus confer a solid immunity. This interpretation clarifies the apparently puzzling phenomenon in which some of the guinea pigs treated with the same dose of virus (0.1 cc) but with larger amounts of immune serum (0.4 cc) did not develop immunity. Under these circumstances the virus was evidently rendered completely innocuous and the antigenic properties altered by the excess serum.

Whatever the intrinsic nature of these phenomena may be, they strengthen the emphasis laid originally by Besredka[5] on the role of the skin in infection and immunity. Due to certain autonomy of the skin as an organ it is possible by intradermal introduction of an attenuated pathogenic agent (bacterial or viral) to create a local immunity which is a step toward the production of a general immunity. In our work a local interception of the virus was achieved in various degrees by minute doses of specific anti-serum. Thus far the interception of the virus is still possible after 18 hours, but further experiments are in progress.

It will be of interest to determine whether it is possible to prevent the disease by the above method when the original tick virus is used.

LUDWIK ANIGSTEIN
MADERO N. BADER
GERALD YOUNG

DEPARTMENT OF PREVENTIVE MEDICINE AND PUBLIC HEALTH, UNIVERSITY OF TEXAS, MEDICAL BRANCH

SCIENTIFIC APPARATUS AND LABORATORY METHODS

OBSERVATIONS ON THE BIOLOGICAL VALUE OF A MIXTURE OF ESSENTIAL AMINO ACIDS[1]

IN a series of convincing experiments, Rose[2] established the conception, now generally accepted, that only nine amino acids are essential for the growth of the rat, but that a tenth, arginine, must be supplied to attain maximal growth. The technique employed by him consisted in eliminating amino acids one at a time from a dietary mixture containing both essential and non-essential amino acids. Impairment of growth occurred only when one or another of the ten "essential" acids was eliminated.

[1] N. H. Topping, *Publ. Health Rep.*, 55: 41, 1940.
[2] C. H. Andrewes, *Jour. Path. and Bact.*, 31: 671, 1928.
[3] R. W. Fairbrother, *Jour. Path. and Bact.*, 35: 35, 1932.
[4] R. H. Green and R. F. Parker, *Jour. of Immun.*, 45: 171, 1942.

[1] From the Department of Pediatrics, Johns Hopkins Hospital, Baltimore, Maryland. This investigation was aided by grants from the Rockefeller Foundation, Nutrition Foundation, Merck and Company and E. R. Squibb and Sons.

[2] W. C. Rose, *Physiol. Rev.*, 18: 109, 1938.
[5] A. Besredka, "Études sur l'immunité." Paris, 1928.

In addition to these classic studies, Rose stated in 1938[3] that animals whose only source of dietary nitrogen was a mixture of the ten essential amino acids "gained in weight just as rapidly as when all the protein components were supplied preformed." These latter experiments have never been published in detail. The question as to whether a mixture of essential amino acids provides an adequate substitute for dietary protein or complete protein hydrolysates has obvious practical implications. The recent study of Elman and Lischer[4] in dogs suffering from shock and that of Bauer and Berg[5] in mice have shown that a mixture containing only essential amino acids is distinctly inferior to a complete amino-acid mixture. In view of these results, it seemed desirable to us to carry out further experiments on rats in which the growth and nitrogen retention of animals whose sole source of N was an essential amino-acid mixture was compared with those of animals receiving complete amino-acid mixtures.

Experimental

Studies were carried out on young animals from a hybrid colony of albino and hooded Norwegian rats. Four diets were used which differed only in the composition of the nitrogenous moiety.[6] In diet "EAA," nitrogen was furnished as an essential amino-acid mixture[8] which differed, however, in some respects from that of Rose: the proportion of biologically "effective" amino acids used was that found in a typical animal protein—casein, and in addition a small amount of cystine was added. In diet "A," the nitrogenous moiety consisted of Amigen,[9] an enzymatic digest of casein in which approximately 15 per cent. of the nitrogen is derived from pancreatic protein. In diet "CTH," nitrogen was supplied as an acid hydrolysate of casein prepared in this laboratory which had been fortified with 1 per cent. cystine and 1.5 per cent. tryptophane, and in diet "C" it was supplied as unhydrolyzed casein. The food intake of animals on the "A," "CTH" and "C" diets was restricted to that of the animals on the essential amino-acid mixture.

[3] Ref. 1, page 129.

[4] R. Elman and C. E. Lischer, *Jour. Am. Med. Asn.*, 121: 498, 1943.

[5] C. D. Bauer and C. P. Berg, *Jour. Nutr.*, 26: 51, 1943.

[6] The basal diet had the following composition:

Nitrogenous moiety	108.5 gms
(In the case of the essential amino-acid mixture, the quantity taken was 138.3 gms, allowance being made for the non-utilizability of the unnatural forms of certain amino acids added in the racemic form.)	
$NaHCO_3$	20.0 gms
Mineral mixture[7]	14.8 "
Sucrose	110.7 "
Starch	310.0 "
Agar	14.8 "
Cod liver oil	36.9 "
Crisco	140.0 "
Brewer's yeast	31.2 "

[7] W. M. Cox and M. Imboden, *Proc. Soc. Exp. Biol. and Med.*, 34: 443, 1936.

[8] Essential amino-acid mixture:

l-tryptophane	4.5 gms
l-lysine HCl	19.2 "
l-cystine	2.5 "
d-histidine HCl	6.8 "
d-arginine HCl	12.7 "
l-leucine	12.0 "
l-leucine—isoleucine mixture	14.0 "
dl-valine	32.0 "
dl-methionine	7.0 "
dl-phenylalanine	15.6 "
dl-threonine	12.0 "
	138.3 gms

Results

The weight curves of animals on these different diets are shown in Fig. 1. The poorest performance was that of the animals on the "EAA" diet. These animals lost weight steadily and one of them succumbed during the second week. The general appearance of

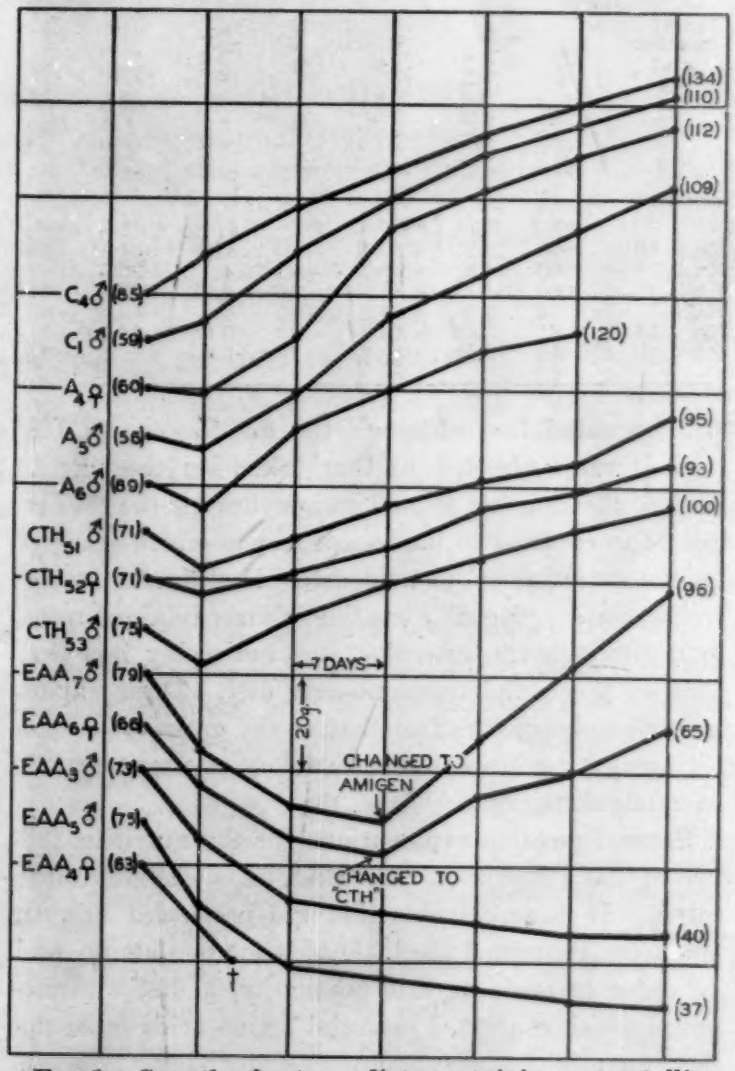


FIG. 1. Growth of rats on diets containing a crystalline amino acid mixture, reinforced acid hydrolyzed casein, Amigen and casein. The numbers in parentheses denote initial and final weights of the rats.

[9] Kindly furnished by Mead Johnson and Company, Evansville, Ind.

these animals likewise was far from thriving. When a change was made to the Amigen ("A") diet or the fortified acid hydrolysate ("CTH") diet, gain in weight was promptly restored. The superior growth of animals on the Amigen diet as compared with the "CTH" diet may well be due to the pancreatic proteins present in Amigen, proteins which have recently been shown to have a high nutritive value.[10] The growth curves of animals on Amigen are comparable to those on casein with the exception of a slight lag when the animal is first put on Amigen.

Nitrogen balance studies were made on six additional animals which were fed the "EAA" diet. These studies were repeated after the diet had been changed to "CTH" diet. The data are shown in Table 1. It

TABLE 1

NITROGEN BALANCE OF RATS MAINTAINED ON THE AMINO ACID MIXTURE AND REINFORCED ACID HYDROLYZED CASEIN DIETS

Rat number and sex	Initial body weight	Amino acid mixture diet 4×3 day periods			CTH diet 4×3 day periods		
		Average daily food intake	Average N-balance per day	Weight change	Average daily food intake	Average N-balance per day	Weight change
	gms	*gms*	*mgms*	*gms*	*gms*	*mgms*	*gms*
EAA–10 ♂	60	4.2	+22.5	−20	4.0	+31.1	+5
EAA–11 ♂	60	4.4	+29.7	−17	4.0	+30.2	+4
EAA–12 ♂	60	4.1	+31.8	−16	4.0	+42.0	+9
EAA–13 ♂	52	3.9	+29.2	−15	4.0	+46.0	+8
EAA–14 ♂	61	3.45	+12.8	−21	3.67	+36.0	+7
EAA–15 ♂	44	3.90	+19.8	−10	3.92	+40.8	+7

will be noted that although the diet on the "CTH" period was restricted to that taken on the "EAA" period, the animals gained weight during the "CTH" period in contrast to the loss of weight which occurred on the essential amino-acid diet. Despite the loss of weight on the "EAA" diet, the animals retained nitrogen, although the retention was noticeably less than that on the complete amino-acid diet. These experiments emphasize the fact that *in the growing animals* nitrogen retention can not be taken as a criterion of adequate nutrition.

Several possible explanations for the nutritive failure of the animals on the "EAA" diet suggest themselves. It is conceivable that the particular mixture employed contained too little of some one amino acid. In order to evaluate this possibility, a diet was prepared which contained essential amino acids in double the quantity used before (comprising 29.4 instead of 14.7 per cent. of the diet). Control experiments were carried out in which the nitrogenous moiety was supplied as "CTH" hydrolysate at twice the previous level. The food intake of the control animals was restricted to that of the "doubled EAA" group. The control animals on "double CTH" all survived, although their weight curves were flatter than those of the animals on 14.7 per cent. "CTH." On the other hand, the results on the high intake of essential amino acids were most unsatisfactory. Of six rats (54–60 gms) submitted to this diet, 3 ate well and died within 5 days, the other 3 ate the diet poorly and survived until sacrificed 3 weeks later. The weight loss in these animals was much more striking than in the 14.7 per cent. "EAA" animals.

It seems possible that the toxic effects of the high "EAA" diet as compared to the high "CTH" diet are brought about by the unnatural isomers of certain amino acids which can not be utilized by the animal. Bauer and Berg[5] attribute their unfavorable results with mice on a ten amino-acid diet to the "cost" of the additional synthetic work the organism is called on to perform—in energy and in building materials, undoubtedly factors of importance, but it is difficult to attribute the effects observed in our animals to other than a toxic cause. The possibility that one or more unutilizable optical forms of amino acids may exert a toxic influence is one that demands verification by direct experiment, and until it has been definitely excluded it would seem wise to employ only the natural forms in human therapy.

SUMMARY

(1) A mixture of "essential" amino acids, fed to rats, was found to be inferior from a nutritional point of view to enzymatic or acid casein hydrolysates or casein fed at comparable levels.

(2) Evidence is presented which suggests that the nutritive inadequacy of the essential amino-acid diet may be due in part to toxic effects of unnatural forms of certain amino acids that can not be utilized.

ANTHONY A. ALBANESE
VIRGINIA IRBY

[10] A. White and M. A. Sayers, *Proc. Soc. Exp. Biol. and Med.*, 51: 270, 1942.

BOOKS RECEIVED

Biographical Memoirs. Vol. XXII. National Academy of Sciences of the United States of America.

ANDREWS, ROY CHAPMAN. *Under a Lucky Star.* Pp. 300. The Viking Press. $3.00.

BARBOUR, THOMAS. *Naturalist at Large.* Illustrated. Pp. 314. Little Brown and Company. $3.50.

SHARP, LESTER W. *Fundamentals of Cytology.* Illustrated. Pp. x+270. McGraw-Hill Book Company. $3.00.

SMALL, SIDNEY AYLMER and CHARLES RAMSEY CLARKE. *Simplified Physics.* Illustrated. Pp. ix+428. E. P. Dutton and Co. $3.00.

STRONG, EVERETT M. *Electrical Engineering Basic Analysis.* Illustrated. Pp. xii+391. John Wiley and Sons. $4.00.

TURRENTINE, J. W. *Potash in North America.* Illustrated. Pp. 186. Reinhold Publishing Corporation. $3.50.